the land is northward. As soon as the border of the ice had receded beyond the watershed dividing the basins of the Minnesota and the Red Rivers, it is evident that a lake, fed by the glacial melting, stood at the foot of the ice-fields, and extended northward as they withdrew along the Red River valley to Lake Winnipeg, filling this valley and its branches to the height of the lowest point over which an outlet could be found. Until the ice-barrier was melted upon the area now crossed by the Nelson River, thereby draining this glacial lake, its outlet was along the present course of the Minnesota River. At first its overflow was upon the nearly level, gently undulating surface of the drift, about 1,100 feet above the sea; but in process of time this cut a channel 125 to 150 feet deep and from one to two miles wide, in which lie Traverse and Big Stone Lakes, respectively 970 and 962 feet above the sea. From this outlet the plain of the Red River valley, 30 to 50 miles wide, stretches 315 miles north to Lake Winnipeg, which is 710 feet above the sea. Along this entire distance there is a very uniform continuous descent of a little less than one foot per mile. The drift deposited by the ice-sheet upon this area, together with that which may have been dropped by floating ice borne on the waters of the lake, and the silt brought in by glacial rivers and by those of the surrounding land, were here received in a lake, shallow near its mouth, but becoming gradually deeper northward.

Beyond our national boundary, Lake Agassiz covered a broad expanse, including the basins of Lake Winnipeg, Red and Rainy Lakes, and the Lake of the Woods. Its breadth varied from 100 to 200 miles, with an extreme length of at least 600 miles and an area, at the time of its greatest extent, exceeding that of Lake Superior.

The most interesting geological features of the basin of this ancient lake now observable are the terraces or beaches formed along its shores at different levels as its outlet was gradually lowered by erosion. These beaches are continuous ridges of sand and gravel, unbroken, save where crossed by modern streams or expanded into the deltas of the ancient lake, whose outlines are thus accurately traced at four distinct levels. The highest or Herman beach is, at the southern end of the lake, 1,045 feet above the sea, or 85 feet above Lake Traverse, and the lowest beach.

Mr. Upham's careful determinations of the altitudes of the beaches have fully established the remarkable fact that the beaches are not level, but have a gradual ascent northward, as compared with the present level line or the surface which a body of water would have now if confined in this valley. The rate of ascent of the highest or Herman beach increases gradually from six inches a mile at Lake Traverse, to above sixteen inches a mile near the national boundary, the total ascent in this distance being 185 feet.

The several beaches are not parallel, the rate of ascent diminishing from the highest to the lowest beach. Thus the second beach is 120 feet, the third 65 feet, and the fourth or lowest 35 feet, higher at the national boundary than at Lake Traverse.

The altitude of the beaches is a function of the longitude as well as the latitude; for a comparison of these beaches in Dakota and Minnesota at the same latitude reveals an ascent from west to east similar to that from south to north, but of less amount, and diminishing in a similar ratio between the successive stages of the lake.

Various causes for these interesting phenomena are suggested and reserved for future discussion; but Mr. Upham indicates his adoption provisionally of the view that the divergence of these ancient shore-lines from the present level line was produced by the gravitation of the water of the lake toward the ice-sheet. At first this attraction would have been relatively large, because of the nearness of the great mass of ice on the north-east in Minnesota and northward in British America; but, as the ice retreated, it must have been gradually diminished, and reduced to a comparatively small influence by the time the ice-sheet had withdrawn so as to permit the northward drainage of the lake.

NOTES AND NEWS.

TWO new methods of determining the density of the earth are being experimented upon at Berlin. The one, by Dr. F. Richarz and Dr. A. König, has been referred to in *Science* (v. 217). These gentlemen apply a sensitive balance with a double pair of scales, one swinging above, the other below, a heavy parallelopipedic mass of lead, which consists of a number of blocks which are exactly measured and weighed. The blocks are perforated, and the wires connecting the upper and lower scales pass through the shaft formed by these perforations. By an ingenious arrangement, the weights, which consist of spheres of lead, can be changed from the upper to the lower scales without opening the case in which the balance is enclosed. The principle on which the experiment is founded is, that, if one of two equal weights is below, the other above, the mass of lead, its attraction will diminish the weight of the former and increase that of the latter. The proportion between this increase and the total weight gives the means for determining the proportion between the attraction and masses of the lead and the earth. Preliminary experiments made with this balance show that a great exactness of the definite measurements may be expected. These experiments are being carried on under the auspices of the Berlin Academy of Sciences in a casemate of Spandau. At the same time J. Wibring is experimenting by another method in the astrophysical observatory at Potsdam. He uses a pendulum made of a brass tube one metre in length and four centimetres in diameter, with spheres of cast iron weighing five hundred and fifty grams at the two ends. A knife-edge of agate six centimetres in length passes through the centre of the tube, and swings on an agate rest. Two small mirrors are attached to the knife-edge, and the oscillations of the pendulum are observed through a telescope. The time of oscillation of the pendulum may be so nicely regulated that oscillations of five minutes length are perfectly regular. Near the iron spheres and opposite to one another, two iron cylinders weighing 325 kilograms are placed, the lower one attracting the lower end of the pendulum to one side, the upper one the upper end to the opposite side. The attraction of these masses affects the oscillations of the pendulum. The result of these observations for the mean density of the earth is 5.594 ± 0.032. The mean of former reliable observations being 5.57, the new figure corresponds well with these. Both experiments will result in a more accurate and trustworthy determination of the mass of the earth.

— In a recent paper on literary catalogues, Mr. Samuel H. Sindeler makes some suggestive remarks about the system of cataloguing now so much in favor. To quote his words, "Paradoxical as it may sound, the very excellence of his [Dewey's] plan is one objection to it. Mr. Dewey multiplies co-operative advantages to those who use his system to such an extent, that if he lives long enough he will make it so much to the advantage of newly forming or growing libraries to use it, that none will be independent enough to modify it. And why should they wish to modify it? Simply because, less than fifty years ago, the present scheme could not have been formed. There was not knowledge enough in the world. There could not now be found, in any scheme then formed, place for a long range of subjects which appear in his actual classification. This is especially true in science, and who shall say that history will not repeat itself in the next fifty years? Let us rather work out the problem of the decimo-mnemonic system on different lines, each library or group of libraries for itself, according to the special needs of the same. Then new Deweys will arise and ply their ingenious arts, and in the millennium the fittest will survive. At present there is danger that the fittest will be handicapped. To give the fittest, when it comes, an earlier chance of survival is one purpose of this paper."

— Cumming's 'Electricity Treated Experimentally,' which was reviewed in the last number of *Science*, is published in America by D. Van Nostrand.

LETTERS TO THE EDITOR.

*** The attention of scientific men is called to the advantages of the correspondence columns of* SCIENCE *for placing promptly on record brief preliminary notices of their investigations. Twenty copies of the number containing his communication will be furnished free to any correspondent on request.*

The editor will be glad to publish any queries consonant with the character of the journal.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Chrome considered as a Poison.

MY attention has been called to an article by Mr. William Glenn of Baltimore in *Science* (x. 58), entitled 'Chrome considered as a Poison,' criticising a paper of mine in the *Boston Medical and Surgical Journal* on the same subject. Were it not that the criticism appears in a scientific journal of high standing, I should

hardly have considered it as meant to be taken seriously, but, appearing as it does, I must beg space to answer some of the writer's points in some detail. Mr. Glenn says that the paper, "curiously enough, does not offer the slightest evidence that chromium or any of its compounds, in any quantity, however large or small, can injuriously affect the animal body. Furthermore, there is no reliable tradition or literature to that effect." It is barely possible that the gentleman may have been misled by a statement in the paper referred to, that I had been unable to find any reported cases of general or local affection attributable to chrome-mordanted clothing. No evidence was offered as to the poisonous character of chromium compounds on the animal body, for the reason that it was supposed to be a matter of common knowledge with the medical gentlemen before whom the paper was read. As to literature, I suppose that everybody will concede the reliability of the few authors (out of many) whom I will quote.

Wharton and Stillé (*Medical Jurisprudence*, 4th ed. vol. ii., Philadelphia, Kay & Bro., 1884) say of bichromate of potassium, "This salt, being extensively used in dyeing, has given rise in several instances to accidental poisoning. Locally applied, its action is irritant, causing in the workmen who use it troublesome sores and ulcerations upon the hands. Taken in poisonous doses internally, its action is highly irritant also, and death has been caused by it with the symptoms usually attending the action of irritant poisons. . . . Several fatal cases have occurred in Baltimore." A number of cases are reported in detail. "Experiments upon animals have shown, that, after the subcutaneous injection of chromic acid, animals suffer from vomiting, diarrhœa, albuminuria, and finally die in a few days: after death inflammation of the kidneys is found. The same results were produced by the injection of a neutral chromate (yellow chromate of potassium)."

Taylor (*A Treatise on Poisons*, London, Churchill) says, "There can be no doubt that bichromate of potassium is an active poison," and quotes the following case from Beck's 'Medical Jurisprudence,' which is also quoted by Stillé: "Dr. Baer of Baltimore has reported the following case. A man, in drawing off a solution of the bichromate by a siphon, accidentally received a small quantity into his mouth. In a few minutes he perceived great heat in the throat and stomach, and this was followed by violent vomiting of blood and mucus. The vomiting continued incessantly until his death, which took place in five hours. On dissection the mucous membrane of the stomach, duodenum, and about one-fifth of the jejunum, was destroyed in patches. In this case the salt acted as a corrosive irritant."

Schuchardt (*Maschka's Handbuch der gerichtlichen Medicin*, Band ii., Tübingen, 1882) says, "Poisoning by chrome compounds (including lead chromate) is not rare. The chromic-acid compounds are more or less violent poisons." Reference is made to numerous cases. "According to the researches of E. Pelikau (*Beiträge zur gerichtl. Med. Toxikologie und Pharmakodynamik*, Würzburg, 1858), bichromate of potassium is very similar in action to arsenic and corrosive sublimate. It causes, when taken into the stomach, marked inflammation of the same and of the intestine; easily causes vomiting, and, after absorption into the system, calls forth a train of general symptoms, particularly albuminuria and hemorrhage from the kidneys, and causes death with more or less rapidity." Reference is made to the results of the observations of Gergens (*Arch. für experiment. Pathol. u. Pharmakol*, Band vi., 1876), Weigert (*Die Bright'sche Nierendegeneration vom pathologisch-anatomischen Standpunkte*), and Kabierske (*Die Chromniere*, Breslau, 1880). The experiments of Gergens were repeated by Posner (*Virchow's Archiv für pathol. Anat.*, Band lxxix., Heft 2), with the same results. "The action of this poison on the general system is extraordinarily rapid and intense."

Falck (*Lehrbuch der Practischen Toxikologie*, Stuttgart, 1880) says, "Cases of poisoning by compounds of chromium are not rare. We find reported up to the present time (1880) seventeen cases, of which three were from chromic acid, two from the chromate and twelve from the bichromate of potassium. Of the seventeen cases, nine (or 53 per cent) ended fatally. . . . Workmen in dye-houses who have to deal constantly with solutions of chrome compounds are afflicted with painful deep ulcers on the hands, which heal with great difficulty; similar affections may be produced by the same substance in the form of dust. . . . Experiments on the effects of chromates on animals have proved the intense poisonous action of these substances. According to Gergens, rabbits died after the subcutaneous injection of 0.26 of a centimetre of chromate of potassium, and showed hyperæmia of the intestinal tract, nephritis, and cystitis. According to Priestley, the vaso-motor centre is first excited, then paralyzed. Mayer found chromium in the blood, heart, liver, and kidneys."

Many more authors could be quoted on this point, but the above is, I think, enough; and, furthermore, the evidence quoted is a sufficient reply to the negative evidence of the weavers in the Philadelphia mills, the dyers, and bichromate-makers interviewed by Mr. Glenn. With regard to the cases reported by me as being caused by chrome mordants, I wish to say, in the first place, that they were not reported for the purpose of beginning an agitation against the use of bichromate as a mordant, nor was it my idea to cause needless alarm among the people. The paper was written for a medical society, and was intended to call to the attention of the members a possible cause of affections of the skin, the removal of the cause in any given case being of a certain value in treatment. I am very well aware of the great value and importance of the bichromate as a mordant, and also of the fact that to the vast majority of people clothing dyed by its aid is not likely to produce any injury under ordinary circumstances; and any idea of restricting its use as a mordant on account of an occasional idiosyncracy would seem to me as absurd as to legislate against railroads on account of the possibility of accidents. I have worn, as have others of my acquaintance, clothing (including stockings) dyed with the aid of bichromate, without experiencing the least injury therefrom, and the same is undoubtedly true of thousands of others; but neither these facts nor Mr. Glenn's experiments are conclusive evidence that everybody is exempt. The grounds for concluding that the trouble in these cases was due to the mordant seem to me to have been justifiable. Mr. Glenn says on this point, "It would have been strange if he had not [found chromium], since most cloth is chrome-dyed. Had he examined further, equally certain he would have found iron, cellulose, keratin, and some other organic products. Why not assign to one or all of them the maladies of the patients mentioned?" My experience in the examination of cloth for irritants has proved to me that a very large proportion of textile fabrics do not contain chromium in any form whatever, and it therefore never strikes me as remarkably curious in such examinations to find no chromium. In the examination of the specimens in question, no other substance was found which could in any way whatever be considered poisonous. Chromium, then, being the only substance present which is known to act as a poison in certain combinations, was the only substance which could be reasonably suspected. Anybody who has read the original article will, I think, concede that in each case the disturbance was due to something in the cloth. That the conclusion that this something was a compound of chromium was correct, I have very good confirmatory evidence. A young man purchased a cheap pair of trousers, which he wore all summer without drawers, and without perceptible injury. Becoming faded, he had them dyed a dark blue, and shortly after, resuming them under the same conditions as before, he was troubled by an outbreak on the skin of both legs, with irritation and inflammation of a very intense character, particularly on the inner side of the thighs and about the generative organs. Through the courtesy of his physician, I was enabled to make an examination and inquiry, which brought out the fact that the dyer had used bichromate of potassium. The young man had worn the trousers a whole summer without injury, but had suffered intensely from wearing them after they had been dyed with bichromate. Would it, perhaps, be as sensible to ascribe the symptoms to cellulose or keratin?

I cannot see the application of Mr. Glenn's calculation of the loss in weight undergone in a week by a small boy's suit, and of the probable amount inhaled by the wearer, unless he assumes that in the cases reported in my paper the poison was simply inhaled. In these two cases the clothing gave off large amounts of dust, much of which was conveyed to their mouths by wet fingers. Mr. Glenn's figures (that is, that a small boy's suit loses three hundred and forty milligrams in a week) can hardly be taken as a

fixed standard, since the amount of loss will depend much on the particular kind of cloth, and upon the activity and habits of the wearer; and in such calculations it is to be considered that small boys occur in several sizes.

Mr. Glenn's theory of antidotes is in great measure correct, but it must be remembered that many so-called insolubles are soluble in the juices of the body. He goes on to say, "Chromic acid is a very active oxidizer. In contact with organic matter, it is quickly reduced to chromic oxide (a compound insoluble in any of the juices of the animal body). It is a destroyer of organic tissues, therefore. The action of both normal and acid alkali chromates is similar to chromic acid. They destroy organic matter by oxidizing it, chromic oxide being precipitated. . . . When such dust falls upon the mucous membrane, it is quickly reduced by the secretion it finds there, and chromic oxide is precipitated. The membrane is not attacked."

This theory of action is not the one which is held by those who consider chromic acid and chromates true irritant poisons, and as one of the latter persons I am again obliged to dissent. I cannot agree with Mr. Glenn as to the general effect or the local reactions. Wharton and Stillé (*Medical Jurisprudence*, 4th ed. vol. ii.), quoting a case of poisoning by the bichromate of potassium, in which, among other symptoms, suppression of urine occurred, remark, "The suppression of the urine is probably due to inflammation of the kidneys produced by the chromic acid." Falck (*Lehrbuch der practischen Toxikologie*, 1880) quotes a case where violent vomiting and intense abdominal pain occurred soon after the application of chromic acid to a cancerous breast. The patient lay pulseless, with cold skin and cyanotic face, constantly vomiting, to all appearances like a case of Asiatic cholera. Death occurred after several hours. A similar but non-fatal case is reported by Bruck.

These symptoms indicate absorption into the system, and not a mere local oxidation with precipitation of a harmless oxide. The symptoms in most of the reported cases of poisoning by chromic-acid compounds are very similar to the above; and these cases of Mosetig and Bruck are particularly valuable in that the poison was not swallowed, but absorbed from a broken surface.

Speaking of the deaths in Philadelphia following the ingestion of buns colored with chrome yellow, Mr. Glenn remarks, "No one familiar with the oxidizing action of chromic-acid salts, and accustomed to making combustions with lead chromate, would find much difficulty in believing that the small quantity of lead chromate taken by any one victim was reduced while in contact with organic matter in the stomach and intestines, chromic oxide passing out with the dejecta, and lead oxide being left to produce its cumulative effects." Again I cannot agree with him, and I think he would have no difficulty in finding many others who would refuse to believe that the poisonous effects of lead chromate are always due to the lead alone. Schuchardt says in *Maschka's Handbuch*, "Chromate of lead appears to act as a corrosive poison;" and again, "Chromate of lead appears to act more powerfully than the acetate." Wharton and Stillé say, "Although this substance is insoluble in water, and under many circumstances in the stomach and intestinal fluids, sometimes it gives rise to acute poisoning owing to its decomposition after it enters the body. That such a decomposition does occur, and that the chromium may be absorbed, is shown by R. C. Smith (*Brit. Med. Journ.*, 1882, p. 8), who reported a case in which chromic acid was detected in the urine: this was a case of professional poisoning, the patient being employed in weaving yarn colored with chrome-yellow." I will briefly quote another case bearing on this point, reported by Leopold (*Vierteljahrsschrift für gerichtl. Medicin und öffentl. Sanitätswesen*, Band xvii. 29). Four persons engaged some days weaving blankets colored with lead chromate were seized with symptoms of chronic lead-poisoning. During the work the yarn gave off so much dust, that their faces and hair were quite yellow. A two-weeks-old boy was kept in the same room, but was apparently protected by a covering of white woollen cloth. After seven weeks the child became suddenly very sick. Among other symptoms, it had several yellow diarrhœic discharges daily, with restlessness and frequent screaming, during which it dug its hands under the pillows. At first it would drink, but refused food: later on, it drank with some effort, and on the day of its death swallowed with difficulty. The lips were dry, respiration quickened, and death came slowly. On chemical examination after the autopsy, lead chromate was found in the respiratory tract and æsophagus, showing that the cloth had not been a sufficient protection. The rubber nipple which the child had used was found to be free from chromate, most probably because the dust which had adhered to it had been sucked off and swallowed. Among the post-mortem appearances was a perforation of the wall of the stomach. The death of this child was caused by exhaustion following perforation and softening of the stomach, brought on in consequence of swallowing chromate of lead. Neither the symptoms nor the post-mortem appearances could be ascribed to the influence of lead. Part of the chromate in the body was doubtless decomposed, and perforation followed. I agree with Mr. Glenn, that, "if dust from chrome-dyed yarn has any poisonous effects, weavers ought to have some knowledge of it."

Dr. Von Linstow (*Vierteljahrsschrift für gerichtl. Med. u. öffentl. Sanitätswesen*, Band xxi. 60) reports two deaths occurring in boys, aged respectively one and three-quarters and three and one-half years, who together ate six small objects made to represent bees, each piece containing 0.0042 of a centigram of chromate of lead. Both were seized with the same violent symptoms at the same time, a few hours afterward. Among other symptoms may be metioned diarrhœa, convulsions, stupor, great thirst, and difficult deglutition. The younger child died on the second, the elder on the fifth, day after seizure. Among other post-mortem appearances observed in the elder child were destruction of the mucous membrane of the stomach in several places, and ulceration, and perforation of the duodenum. In both cases there was fatty degeneration of the liver. In the younger child there was no perforation, but the mucous membrane of the stomach was marked throughout with red points, and showed velvet-like, opaque swelling. The duodenal mucous membrane was pale, with occasional bloody points. Would anybody think of ascribing these symptoms and post-mortem appearances to lead oxide?

In conclusion, I join Mr. Glenn in the hope that investigation into the subject of chrome-poisoning will not be allowed to die of neglect.

Charles Harrington, M.D.
Chem. Dept. Harv. Med. Sch., Aug. 12.

Poison Fangs and Glands of the Mosquito.

The general arrangement of the mouth of the female mosquito is well described by Dimmock on 'the mouth-parts of the *Diptera*.' The under lip is a large hairy tube, 2 millimetres long, open above, and serving as a sheath for the piercing-apparatus, whilst it is itself terminated by two sensitive labellæ, and by a central lancet-like ligule. Within the structure of the sheath are a large nerve, a pair of longitudinal muscles and many oblique muscles, two large tracheæ by which air can be admitted (so as to distend the organ as in *Musca*), and long filiform tendons which arise at the base of the sheath and support the terminal labellæ.

The piercing-apparatus is enclosed during rest in a strong-pointed upper lip (*labrum*) which is grooved inferiorly for their reception, and which along with them is received into the sheath-like under lip. Within this labrum are the two maxillæ, very sharp and barbed near the tip, and able to play back and forward like saws; also two mandibles, a fine styliform hypopharynx, a delicate sheath for the front segment of the œsophagus, and the œsophagus itself. The last-named organ is received within the head into a strong box-like pharynx, which is well supplied with muscles and is a suction organ. The pharynx draws in blood (and probably vegetable plasm), which it transmits by the long post-pharyngeal part of the œsophagus to the stomach lying in the abdomen of the insect.

The poison-apparatus, which hitherto has been an unknown quantity, is connected with the two mandibles. Each mandible has a large funnel-shaped base, into which is inserted the end of a poison-duct. The thickened axis of the mandible is pierced by a fine canal, which opens just below the sharp apex. The structure reminds one of a bee's sting, saving that it is duplicated. We can by pressure drive out some of the contents and observe them issuing at the sub-terminal orifice. It is probable that when the lancets pierce an object this fang-like mechanism may, by pressing on its base, automatically discharge a portion of the poison. The poison